Light and Lighting

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Colour in the Factory

ONLY a few months ago, at the I.E.S. annual dinner, Lord Marley spoke on the value of colour in the factory, which has recently formed the main subject of a paper by Dr. J. H. Nelson (see page 213). Dr. Nelson shows how closely related are industrial lighting and decoration, how the illuminating engineer must consider the coloration of walls and ceiling, because of their value in reflecting light, and of the great importance of the *background* thus presented.

The illuminating engineer should therefore have a say in the selection of colours as an aid to lighting. Should he also venture on the more debatable ground of the choice of colour, with a view to producing harmonious and pleasing effects? We think he will be well advised at least to study these aspects (which are not so very mysterious), instead of dismissing them as demanding exclusively the "creative skill of the artist."

I.E.S. Informal Meetings

A promising start with the revival of Informal I.E.S. Meetings in London was made on November 25, when Professor H. Hartridge lectured on "Recent Advances in the Physiology of Vision." It was a sign of the times, besides a tribute to Professor Hartridge's reputation as a lecturer, that the lecture theatre of the Lighting Service Bureau was filled to capacity in spite of the somewhat abstruse nature of the subject matter. Professor Hartridge, however, has undeniably a way with him —a breezy handling of complicated phenomena and a cheerful enthusiasm that carry the audience along with him. His elucidation was helped out by home-made but ingenious sketches in colour, projected by the epidiascope, with a narrative effect resembling the captions that used to be attached to silent films. In the discussion the unusual, but, in this case, effective, method was adopted of allowing the author to deal with each speaker's comments as they occurred. There was plenty of room for argument in connection with the theories propounded, and reply, rejoinder, and re-rejoinder followed in brisk succession. No doubt the fact that no formal record of the proceedings was intended helped speakers to express their ideas freely. This experience well illustrates the expediency of sometimes allowing lecturers to follow their own distinctive methods — one does not want to have all addresses cast to precisely the same standards, even if these in themselves are sound and (in general) justified. We understand that there are one or more further informal meetings in prospect, and we hope that such events will become a regular feature of annual programmes.

Next I.E.S. Meeting in London

On **January 13** MR. C. R. BICKNELL will be reading a paper on **The Application of Modern Flash Discharge Tubes** at a meeting of the I.E.S. to be held at the Lighting Service Bureau, 2, Savoy Hill, London.

The paper will deal with the construction, operation, characteristics, and general applications of flash discharge tubes; selected applications will be examined in some detail. Portable, studio, and stroboscopic flash equipment will be shown and demonstrated, and the whole paper will be fully illustrated by slides.

I.E.S. 1946 Convention

Readers are again reminded that the proceedings of the Convention are still available in booklet form, and may be obtained from the Secretary of the Illuminating Engineering Society, 32, Victoria Street, London, S.W.1, at 10s. per volume (six copies for £2 10s. and 12 copies for £4).

Register of Lighting Engineers

We have been asked to announce that the Illuminating Engineering Society is inviting applications for admission to the Register of Lighting Engineers as from February 1, 1948.

It will be recalled that the Register has been established to meet the need for some form of recognition for practising lighting engineers who are Corporate Members of the I.E.S. and who satisfy the Council of the I.E.S. that they possess the necessary qualifications.

The qualifications for admission to the Register will be given in full in a forthcoming issue of the I.E.S. Transactions but briefly they are as follows:—

Applicants for Registration must have:—

(a) been a member of the Society in some class for not less than one year.

(b) passed the Intermediate examination in Illuminating Engineering of the City and Guilds of London Institute.

(c) given satisfactory evidence of knowledge of certain ancillary subjects.

(d) passed through a course of practical instruction or, alternatively, prove that they have been engaged in illuminating engineering practice for an approved period and shown competency therein.

In the case of those Corporate Members of the Society who have had suitable experience in illuminating engineering over an approved period the conditions (b) and (c) above may be waived provided that application is made within a period of two years from the initiation of the scheme (i.e. before February 1, 1950).

Those admitted to the Register will have the exclusive right to adopt the description "Registered Lighting Engineer (I.E.S.)" but a certificate issued by the I.E.S. showing admission to the Register does not convey to the holder any exclusive right to practise as a lighting engineer. The Council of the Society are also empowered to remove from the Register the name of any Registered Lighting Engineer who has ceased to be a Corporate Member of the Society.

Forms of application will be available from the Secretary of the I.E.S. at 32, Victoria-street, London, S.W.1, or from the Hon. Secretary of Local Centres and Groups.

American I.E.S. Handbook on Illuminating Engineering

We are asked to mention that it is hoped to obtain shortly from the American I.E.S. a limited number of the Handbook on Illuminating Engineering which has recently been published and to which reference was made in our last issue.* These are being made available at somewhat less than the published price, but the cost of postage from the United States and the dollar-exchange have to be taken into consideration, and the transmission to America of even the small sum involved in this case involves the completion of certain formalities. In the meantime any I.E.S. members who would like to obtain, through our Society, copies of the handbook are requested to get in touch with the Secretary at 32, Victoria-street, London, S.W.1. As already mentioned the handbook is evidently a very comprehensive volume occupying some 400 pages. The cost to those who purchase in this manner will be of the order of 35 shillings.

* Light and Lighting, November, 1947, p. 198.

New I.E.S. Group in Sussex

The first meeting of a new I.E.S. Group was held at the Brighton Corporation Electricity Showrooms on Thursday, November 20. The chair was taken by Mr. H. Pryce-Jones. Amongst those present were Mr. E. Stroud, a past-president of the Society, and Mr. G. F. Cole, secretary of the I.E.S., and a number of visitors who expressed their interest in the formation of the new group.

After the opening remarks of the chairman, Mr. Stroud reviewed the history and work of the Society, dwelling upon its growth of membership during recent years. He recalled the pioneering work which had been carried out in the early days of the Society by a very small body of enthusiasts with the result that to-day the Society had both a national and an international reputation. The secretary then dealt briefly with the organisation of the Society and the procedure for the formation of Centres and Groups.

In the ensuing discussion it was apparent that the group would be well supported and a committee was elected to arrange a programme of meetings for the remainder of the present session. Mr. A. Sacre was elected chairman, and Mr. O. E. Guyatt was elected honorary secretary.

The next meeting of the Group will be held at the Electricity Showrooms, Brighton, at 7.30 p.m. on January 15, when Mr. L. G. Applebee will lecture on "Coloured and Directional Light as Applied to the Theatre."

I.E.S. Silver Jubilee Award

We have been asked to draw the attention of the younger I.E.S. members and others to the above award, the existence of which does not appear to be sufficiently widely known. In addition to the Leon Gaster Premium, awarded annually for the best paper read before the Society, the I.E.S. offers two awards, both open only to applicants under 26 years of age. The qualification for the Silver Jubilee Commemoration Award (1934), open to I.E.S. members of all ranks (consisting of five guineas and a certificate recording the award), may be the writing of a paper, the design or construction of some novel instrument or the carrying out of an investigation beneficial to illuminating engineering. There is also a second award, for which the conditions are identical, except that candidates outside the ranks of the Society are eligible. Applications for either award should be lodged with I.E.S. secretary (32, Victoria-street, London, S.W.1) not later than June 1 in each year.

Fluorescent Lighting in Kingsway

Attention has been directed recently to the experimental fluorescent lighting to be tried out in Kingsway (London) for the Holborn Council. The fluorescent units are being erected on 25-ft. concrete posts. Twelve such columns are being erected, six being furnished by each of the two firms interested, the British Thomson Houston Co., Ltd., and the General Electric Co., Ltd. If this new system is adopted in the important thoroughfare of Kingsway, it will serve as an outstanding indication of the value of fluorescent tubular lamps for public lighting—an application which at one time was considered doubtful. It seems, indeed, as if a new departure in principle is involved, the low brightness of the new lamps being regarded as a positive advantage, whereas it was formerly assumed that highly concentrated sources, the light from which could be readily controlled and directed, were essential in order to provide high and even road brightness in an economical manner.

Forthcoming I.E.S. Meetings

(Provisional List)

MEETINGS IN LONDON

1948.

Jan. 13th. Sessional Meeting. MR. C. R. BICKNELL on **Applications of Modern Flash Discharge Tubes.** (*At the Lighting Service Bureau, 2, Savoy Hill, London, W.C.2.*) **6 p.m.**

Feb. 10th. Sessional Meeting. MR. G. GRENFELL BAINES on **The Lighting of Architecture.** (*Joint Meeting with the R.I.B.A.*). (*At the School of Hygiene and Tropical Medicine, Keppel Street* (*Gower Street*), *London, W.C.*1). **6 p.m.**

MEETINGS OF CENTRES AND GROUPS

1948.

Jan. 1st. MR. T. O. FREETH on **Lighting for Effect.** (*At Exeter.*)

Jan. 1st. MR. F. C. SMITH on **Gas Lighting.** (*At Cheltenham.*)

Jan. 2nd. MR. T. O. FREETH on **Lighting for Effect.** (*At Radiant House, Bristol.*) **7 p.m.**

Jan. 5th. Joint North Midland Area Meeting at Leeds. (*At the Leeds Corporation Electricity Dept., Whitehall Road, Leeds.*) **6 p.m.**

Jan. 7th. Address by the President (DR. J. W. T. WALSH.) (*At the Cardiff Corporation Demonstration Theatre.*) **6.30 p.m.**

Jan. 7th. MR. E. J. STEWART on **The Lighting of Housing Estates.** (Joint Meeting with the Association of Public Lighting Engineers.) (*At the Reynolds Hall, College of Technology, Sackville Street, Manchester.*) **6 p.m.**

Jan. 7th. Annual Dinner of the Newcastle Centre.

Jan. 8th. MR. G. A. JONES on **Lighting for Photography.** (*At the Corporation of Leicester Electricity Department Demonstration Theatre, Charles Street, Leicester.*) **6.30 p.m.**

Jan. 9th. Annual Dinner of the Birmingham Centre. (*At the Imperial Hotel, Temple Street, Birmingham.*) **6 p.m.**

1948.

Jan. 9th. MR. C. F. HURD on **Industrial Lighting—Planned Maintenance.** (*At the Electricity Showroom, Market Street, Huddersfield.*) **7 p.m.**

Jan. 9th. MR. T. O. FREETH on **Lighting the Home.** (*At the City of Nottingham Gas Dept., Demonstration Theatre, Parliament Street, Nottingham.*) **5.30 p.m.**

Jan. 13th. MR. F. JAMIESON on **Colliery Lighting.** (*At Stoke-on-Trent.*)

Jan. 15th. DR. E. C. WALTON on **Power Factor and the Lighting Engineer.** (*At Bradford Corporation Electricity Offices, Sunbridge Road, Bradford.*) **7.30 p.m.**

Jan. 15th. MR. H. G. JENKINS and MR. J. N. BOWTELL, on **High Voltage Fluorescent Lighting.** (*At the Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank Crescent, Glasgow, C.3.*) **6 p.m.**

Jan. 16th. MR. C. R. BICKNELL on **Recent Applications of High-Speed Flash Discharge Tubes.** (*At the Imperial Hotel, Temple Street, Birmingham.*) **6 p.m.**

Jan. 16th. MR. H. C. JENKINS and MR. J. N. BOWTELL on **High Voltage Fluorescent Lighting** (Joint Meeting with the Royal Scottish Society of Arts). (*At the Heriot Watt College, Chambers Street, Edinburgh.*) **6.30 p.m.**

Jan. 21st. MR. C. DYKES-BROWN on **Cold Cathode Fluorescent Lighting.** (*At the Cleveland Scientific and Technical Institution, Corporation Road, Middlesbrough.*) **6.15 p.m.**

Feb. 2nd. MR. S. W. RICHARDS on **Mine Lighting.** (*At the Leeds Corporation Electricity Dept., Whitehall Road, Leeds.*) **6 p.m.**

Feb. 2nd. MR. L. H. HUBBLE on **Lighting of Retail Stores.** (*At the Medical Library, The University, Western Bank, Sheffield.*) **6 p.m.**

Feb. 4th. MR. P. CORRY on **Light and Colour in Play Production.** (*At the Minor Durant Hall, Oxford Street, Newcastle upon Tyne.*) **6.15 p.m.**

Feb. 5th. MR. H. L. TREDREE on **Future Trends of Fluorescent Lighting.** (*At the Cardiff Corporation Demonstration Theatre.*) **3.30 p.m.**

(Secretaries of Centres and Groups are requested to send in particulars of any changes in programme, mentioning subject, author, place, date and time of meeting; summaries of proceedings at meetings (which should not exceed about 250–500 words) and any other local news are also welcome.)

Presidential Visit to Gloucester

A meeting of the Gloucester and Cheltenham Centre of the I.E.S. was held at Gloucester on December 4, at which the I.E.S. President, Dr. J. W. T. Walsh, and the I.E.S. Secretary, Mr. G. F. Cole, were present. The chairman, Mr. W. A. Chard, in welcoming the visitors, said how pleased the Centre were at having Dr. Walsh with them, and recalled the outstanding work that Dr. Walsh had done in the field of illuminating engineering and the long service he had given to the Society.

In his address Dr. Walsh dealt with the training of the lighting engineer on lines somewhat similar to his Presidential Address to the Society in October last, but departed from the usual custom on such occasions by inviting a discussion. He also mentioned that the Development Committee of the I.E.S. had now almost completed their work on preparing a standard lecture for delivery to schoolchildren, and were now considering the preparation of films and film strips on lighting.

A very interesting discussion followed, in which a number of the Centre members took part. Great interest was shown in the possibilities of films and film strips for showing in schools and technical colleges, and though it was agreed that films were a very useful means of imparting knowledge, it was felt that film strips had many advantages, not the least of which was that they enabled the lecturer to add the personal touch which was so often lacking with films of both the sound and silent types.

Mr. R. W. Steel, a former chairman of the Centre, thought that though a standard form of lecture and set of equipment would be of great help to Centres, the latter could do much of their own accord whilst waiting for sets of equipment to be supplied by headquarters. He himself had been asked to give lectures in Cheltenham, and by making use of gear and equipment which was in almost every-day use, together with a few items which he had been able to borrow, he had found it an easy matter to hold the attention of his audience and to excite their attention in ligthing matters.

Pros and Cons of Fluorescent Lighting

On December 5 the I.E.S. Nottingham Centre arranged a debate on fluorescent lighting, the actual terms of the motion being "that the use of fluorescent lighting is not in the interests of the public"—perhaps not the happiest title. The arguments in favour of the motion covered mainly two features—statements that ultraviolet radiation and stroboscopic effects are responsible for "ruin to eyesight," and the milder and more legitimate views of those who do not *like* the effects of fluorescent lighting. The opposers naturally pointed out that there was no justification for the assumption that harm could be or was being inflicted on eyesight in the manner described.

As regards the questions of taste and appearance, the comparative merits of fluorescent and filament lighting, and the need for discretion in applying the former (one lady in the discussion mentioned an alleged unfavourable influence on complexions), there is certainly scope for discussion and investigation. It seems a pity, however, that this opportunity should be confused by declarations which only physiologists can confirm and for which there seems to be no valid evidence.

Decoration and Industrial Lighting

Summary of a paper read by Dr. J. H. Nelson at the Meeting of the Illuminating Engineering Society held in London on December 9, 1947

The role of lighting and decoration is to produce not only adequate illumination, but also to contribute to the general sense of well-being which is induced by pleasing surroundings. Discussion of the scientific background to such a complex subject is useful. It should not be assumed that a simple set of rules can be deduced which can take the place of the creative ability of the artist. On the other hand it must be appreciated that the conditions necessary for comfortable seeing must be understood and specified if lighting is to be used to its full advantage.

The early work carried out by Lythgoe is well known. More recently Weston, in England, and Luckiesh, in America, have devised methods of assessing the lighting requirements for different tasks. In general the ideal conditions for good seeing are as follows:—

(a) details should be as large as practicable,

(b) critical contrasts should be as high as possible without causing glare (say 50 or 100 to 1),

(c) the central field brightness should be of the order of 1,000 equiv. ft. cdls.,

(d) the immediate surround field should be comparable in brightness with the central field, and in comparison with the more remote surroundings should be so coloured as to yield variety without distraction,

(e) the eyes of the operator should either be relaxed or accommodated well within the comfort range of the individual.

The lighting engineer is faced with the task of interpreting such a set of ideals into a practical lighting installation. To provide good seeing conditions it is necessary to control not only the illumination, but also the nature of the surroundings. The lighting engineer should, therefore, control the paint on ceilings and walls and the finish of machine tools.

Colour Harmony

The decorative use of colour depends on the psychological effects of light, shade, and colour. If the relationship between colours is to be stated in an objective manner some means of measuring and specifying colour must be used. For this purpose the Munsell system has the advantages that it is simple and that a Munsell colour step in any direction corresponds to an approximately equal change in sensation.

The Munsell colours are arranged in what might be described as a colour tree. The greys, or neutral tints, form the trunk which is divided into ten equal steps between black and white, "Value" 0 and "Value" 10 respectively. The colours of the same "hue" are arranged on radial planes projecting from the central trunk and the distance away from the trunk serves to indicate the "Chroma" or depth of colour. When more than two colours are to form a harmony it is found that their points on the Munsell solid should form some regular geometrical figure. For example, a pleasing harmony of three colours of the same value would form a triangle, four colours a square, etc. Such figures may equally well lie in a plane of constant hue or even an oblique plane through the colour solid.

The reaction of an observer to a particular colour harmony depends on two factors (a) the average brightness or value of the whole pattern, and (b) the mean colour which would be produced by mixing all the colours composing the pattern in proportion to their areas. These two factors are, of course, interdependent in their action, the significance of the mean colour being negligible when the value of the pattern is low, but increasing and becoming dominant for a high value.

Application to Industrial Decoration

A scheme of industrial decoration may be regarded as a pattern to be seen by an observer who is adapted to approxi-

mately the mean colour of the scheme, and the wise use of the psychological effects of the mean colour is potentially a great benefit to industry. Probably the greatest field for the application of these effects is in those industries where the work is repetitive and leads to boredom and where a stimulating colour scheme might prove a great asset. It must be realised, however, that the scheme must be planned for the operator who works with it and not to appeal to the casual visitor.

In making any recommendations for the practise of industrial decoration consideration must be given to the question of personal tastes which, as in most subjective assessments, render exact measurements impracticable. With this in mind, the following recommendations are suggested:—

(a) The ceiling should generally be painted white and have an egg-shell finish.

(b) The walls and machine tools, which compose the principal elements of the colour pattern, should be in colours of high value and, whilst presenting variety, should not include contrasts in values. The average reflectivity should exceed 50 per cent.

(c) Advantage should be taken of the aesthetic merit of the value contrast by picking out the skirting on the walls and machines.

(d) The floor can usefully contribute to the general effect, especially in the case of new buildings. A high reflectivity is desirable but a mottled finish may lend interest.

In a large shop the machine tools are by far the most significant part of the decoration scheme. They are apt to get covered with swarf and oil, so that at first sight it would seem impossible to keep them clean if finished in a light colour and impossible to maintain the light finish unblemished even if cleaned regularly. In practice, however, it has been found that machines are kept clean just because the dirt *does* show. Generally an oily machine means a faulty machine, the light finish shows up the oil and enables the machine to be serviced immediately.

As might be expected, the experience of such a decoration scheme in a precision shop and in the hands of craftsmen cannot be taken as general for all other shops where the tempo of work is quicker and only semi-skilled labour is employed. However, even in mass-production shops, the use of the same Portland Stone finish has proved practical on all special purpose machines.

Old Buildings

Much of the work that has been carried out on industrial decoration has been done in old buildings, which has limited the extent to which the scheme could be applied. It is difficult to give satisfactory treatment to old floors, and services in most existing factories have been installed in a rather haphazard manner the reorganisation of which would be an expensive and tedious task. The planning of overhead services has become a matter of major importance in the relighting and re-decorating of many shops.

The problem of maintenance is one of the most important to be faced in both lighting and decoration, and schemes must be planned so that this cost is kept within bounds. The repainting of a large factory may take a very long time and a straightforward and simple policy should therefore be adopted.

For some time to come it must be expected that the majority of industrial decoration will have to be carried out in old, or at any rate existing, buildings. Whilst this may not allow the decorator or lighting engineer to show his capabilities to the full, it is important to realise that there is an enormous amount of valuable work to be carried out.

As with lighting, so with decoration, the cost of an installation in relation to its value in terms of increased production is very difficult to assess, but in both cases it should be remembered that quality is much more important than quantity. In spite of the lack of accurate data on which to assess the advantages of good seeing conditions, it is usually found that managements can be convinced of these as soon as the initial step has been taken.

The Polychromatic Theory of Human Vision

In what follows Prof. H. Hartridge gives a summary of the lecture which he gave at the first Informal Meeting of the Illuminating Engineering Society, which was held in London on November 25th, 1947

Views concerning human colour vision are in a state of flux at the present time. Whereas forty years ago the results of research appeared to be almost completely in favour of the three-colour theory of Thomas Young they now seem to be increasingly in favour of a polychromatic theory. This change in outlook is due not only to improvements in the old methods of research on such properties of the eye as colour mixture, hue discrimination, saturation discrimination and the luminosity curve, but also to the introduction of new methods of investigation, such as the microelectrode technique as introduced by Professor Granit of Sweden. To-day, in consequence, there is hardly a single facet of human colour vision which is not more adequately covered by a polychromatic rather than by a three-colour theory.

The Author's Theory

Polychromatic theories are not new; one was proposed by Wundt many years ago and another has been proposed by Edridge-Green. These differ considerably in detail from the one which has been suggested by the author. This theory, which is of a purely experimental nature and is therefore subject to considerable revision, may be stated briefly as follows: There are present in the retina seven receptors—one for each colour of the spectrum; together these form three units—a fundamental three-colour unit, comprised of the orange, the green and the violet receptors; in addition there are two subsidiary units, one comprising the red and the blue-green, the other comprising the yellow and the blue. The three-colour unit resembles in nearly all its main features the three-colour unit required by Young's theory. The two subsidiary units resemble in many respects those required by Hering's theory. Thus the polychromatic theory in its present form resembles what amounts to a summation of Young's theory with Hering's theory. The polychromatic theory accepts the duplicity theory, so that twilight vision is accounted for in the normal manner.

The response curves of the three-colour unit probably closely resemble those suggested by Pitt. It is this unit which is found in a pure, or almost pure, state in the protanomalous subject. The red-blue-green unit is observed in a nearly pure state when the fovea is being used at small visual angles, at low light intensities or at both. On the other hand the yellow-blue unit is observed in a nearly pure state towards the periphery of the retina and when the fovea is being used for colour vision at very high light intensities. The presence of these two additional units in normal vision and their absence from the protanomalous subject cause the very big differences in hue discrimination and other properties of colour vision which are found between these two types of subject. Other forms of colour-blindness are accounted for as reductions of the tri-colour unit, just as they are on the basis of the three-colour theory.

Advantages of the Theory

The main advantages of the polychromatic theory may be summarised as follows: It gives for the first time an adequate account of the differences between normal and colour-blind persons. It provides a complete description of the phases of vision encountered when light intensities, both high and low, are used for foveal perception and also when the peripheral part of the retina is being used instead of the fovea. It also provides an explanation of the many different fixation points found by the author, and the many fixed hues observed under retinal micro-stimulation. It accounts for the retinal direction effect of Stiles and Crawford, and also for the complexity of the hue discrimination curve, neither of which can be explained by the trichromatic theory. So far the author has found no fact concerning human colour vision at variance with the polychromatic theory.

Following the lecture, an interesting discussion took place and was opened by Dr. E. N. Willmer, of the Physiological Laboratory, Cambridge, who raised the question of colour blindness and colour deficiency. Amongst others who took part were Dr. M. H. Pirenne, of the Department of Physiology of University College, London, Mr. P. J. Waldram, a well-known member of the Illuminating Engineering Society, and Mr. G. H. Giles, secretary of the British Optical Association.

The Design of Industrial Equipment

In what follows we give a summary of the discussion of the paper on the above subject read by Mr. F. Widnall to the I.E.S. in London on November 11th, 1947, and summarised in our last issue (November 1947, p.196)

The discussion was opened by Mr. R. A. Joseph, who said that as one concerned with the installation and maintenance of industrial lighting equipment he perhaps saw such equipment at its worst. Lighting fittings often receive their roughest treatment whilst being installed. Electricians often had to work at the top of a ladder in semi-darkness. Fittings should therefore be easy to handle; detachable heads to facilitate wiring were advantageous.

A design should be functionally correct, not only initially but throughout life. The designer should aim at being one step ahead of the user, anticipating his requirements. Good quality vitreous enamel was essential. The lightness of aluminium was an advantage, but he gathered that with this material a special patent form of enamel would have to be used. He was surprised at the poor quality of enamel often offered, and at the suggestion that paint might serve as a substitute.

Proceeding, Mr. Joseph discussed at some length the design of lamp-holders and the problem of providing against the effect of vibration, which he had sometimes countered by putting a pad of rubber in the suspension. He agreed that the best mode of testing was in service; tests designed to imitate service conditions never did so completely.

Mr. S. D. Lay, referring to fluorescent lighting equipment, stressed the importance of angle of cut-off, efficiency of vitreous enamel finishes and variations in distribution due to reflector shape and finish. Such questions as the proportion of upward light and the optimum angle of cut-off, which might vary in different situations, deserved consideration. On such points little published information was available. Maintenance was very important. It was improvident to use a fitting which was efficient when new, but in a few years deteriorated greatly. Manufacturing cost should be considered in connection with cost of transport, storage and erection. Vitreous enamelling had not proved inferior to paint in regard to damage in transit. It did, however, increase materially the weight of fittings. He strongly urged that designers of fittings should study how their equipment behaved in use, and acquire information from contractors and users on this point.

Mr. G. D. Mason, speaking on behalf of Mr. Alpress, read a contribution in which such matters as corrosion, heating and flame-proof lighting were discussed. He, too, suggested that more attention should have been devoted in the paper to ease of erection, maintenance and packing for export. Anodised and properly sealed aluminium reflectors gave a good life when reasonably treated. Electrolytic corrosion, e.g., at the junctions of iron and aluminium, did, however, deserve study. In regard to flame-proof lighting a great difficulty at the present moment was the limited supply of toughened glass available.

Dr. J. N. Aldington deplored the poor maintenance of many units. B.S.S. 161 illustrated the steady progress in the efficiency of electric lamps through the years. It would be interesting to get similar data in regard to fittings. The physical maintenance of lighting fittings was of great importance.

He presumed the author was referring to plastics used for coverings of lighting fittings, but recent work had been done on the spraying of metal, subsequently polished, on plastic surfaces. One type of choke, the cubic choke, could be made practically noise-free, but this was more difficult with the elongated design.

Mr. J. B. Harris said that some fluorescent fittings had to be practically dismantled when it was necessary to change the lamp or starting switch. Standardisation was desirable in certain directions, e.g., in regard to design of chokes and starter switches.

Mr. C. R. Bicknell, referring to electrolytic corrosion, asked the author to name those metals to which aluminium was most antipathetic. The author had mentioned vitreous enamel backing for mirrors. Could this be applied without distortion? The use of plastic for flameproof equipment presumably was regarded as applicable to fluorescent fittings; otherwise trouble due to temperature rises might ensue. As regards optical tests, users were primarily concerned with the question whether light was being distributed in the desired manner rather than in overall efficiency.

Mr. F. C. Smith suggested that the difficulty of pre-determining the efficiency of enamels had been rather over-

estimated. In the laboratory with which he was associated, tests for resistance to abrasion and impact, acid, thermal shock, etc., had been devised and answered well. But it was their practice to correlate such tests with records of experience in practice and to collect instances of difficulties as they arose. If the attention of manufacturers was constantly drawn to troubles experienced in practice, the comparatively simple problem of enamelling lighting equipment should be readily solved.

Mr. H. C. Weston pointed out that the efficiency of local lighting fittings, likely to be increasingly used to secure high values of illumination or because of the fuel shortage, was of some importance. He had recently been concerned with the provision of illumination by means of units placed near to the work, and had been surprised at the apparent low efficiency of fittings used for this purpose.

In addition to the above, there were a number of communicated contributions from others not present at the meeting. Mr. A. Cunnington joined in emphasising the importance of maintenance and, in particular, ease and simplicity in fixing and wiring of fittings, which were apt to be overlooked. Would it not be desirable to get the views of good practical wiremen at an early stage in design? Mr. Howard Long remarked that anodised aluminium reflectors were not necessarily easier or cheaper to make than other types. He did not agree that vitreous enamel finishes did not give good service in acid-laden atmospheres, nor that they were unsuitable for use with fluorescent units. Mr. R. W. Stevens discussed the testing, for optical performance, of fluorescent lighting fittings, and gave some relations illustrating the effect of distance on tests. From these it was shown to be unnecessary to have the photo-cell as far distant as 30 ft.—in fact, the writer had found a distance of 6 ft. to be quite adequate. Mr. C. L. Schramm contended that this country is too conservative in exploring new fields, that consumers should be educated to put chief emphasis on quality rather than price, but that aluminium castings were much too expensive. Industry still awaited a moulding plastic with high thermal resistance; and development in finding more compact fluorescent light sources and simpler auxilliaries had still a long way to go.

Lectures to School Children

Reference has been made in these columns from time to time of the very successful lectures to school children which have been given in the past by the various centres and groups of the I.E.S. It will also be recalled that a specimen lecture* was given by Mr. S. S. Beggs and Mr. W. R. Stevens to a joint meeting of the Society and the Science Masters' Association which was held in London on April 17 last year.

The Development Committee of the I.E.S. has now produced a standard form of lecture, together with a prototype set of demonstration equipment, the preparation of which has been based on experience gained from lectures already given. It is intended that the lecture should be made available to school children between the ages of 13 and 16, and initially no attempt has been made to produce a series of lectures each directed to different age groups, it being considered preferable at this stage to have only the one form of lecture. The lecture is so framed, however, that lecturers might introduce their own modifications to suit their particular audience if they so desire.

As a result of the questionnaire which was recently addressed to members of the Society it is apparent that a large number of members of the Society are prepared to give this lecture to school children. It is understood that as it stands the lecture would present no difficulty to the great majority of members of the Society, and the detailed list of experiments and set of demonstration equipment will greatly simplify the task of the lecturer. The demonstration equipment has been made to fit into simple containers which are easy to handle.

As a first step to securing the adoption of this lecture a demonstration has been arranged for members of the Society. For the benefit of those residing in the provinces this demonstration will take place in the *Reynolds Hall* of the *Manchester College of Technology*, Sackville-street, Manchester, at 2 p.m. on *Friday, January* 30, 1948. All members of the Society are invited to be present.

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* Trans. Illum. Eng. Soc. (London), Vol. XI, No. 7.

Experimental School Lighting in Leeds

An interesting report, issued by the City of Leeds Education Committee, describes some experimental lighting installed in the Sandford Secondary Modern School. In a foreword, acknowledgment is made of the aid of the Electric Lamp Manufacturers' Association of Great Britain, Ltd., who co-operated in these experiments and of that of Mr. J. W. Howell, the area engineer of the Association's Lighting Service Bureau.

The new fluorescent lighting was installed in four rooms, three 24 ft. by 22 ft. and one 37 ft. by 27 ft. The rooms were all redecorated prior to the installation of the lighting, tints best adapted to lighting requirements being selected. In three cases the upper walls and ceilings were done in eau-de-nil (reflection factor 47 per cent.), with somewhat darker tints for the dado below. In the fourth case the upper walls and ceiling were treated in pale cream (reflection factor 76 per cent.). The arrangement of the fluorescent units in the rooms varied, the consumption in two cases being 630 watts and in the others 1,170 and 1,350 watts respectively.

The original illumination, furnished by tungsten lamps, varied from 5 to 10 lumens per sq. ft. In the new installations the level of illumination was from 10 lumens per sq. ft. upwards, except in one of the 24 ft. x 22 ft. class rooms, where the expenditure of 1,170 watts furnished 18-25 lumens per sq. ft. In general the lamps used had been in service elsewhere for a considerable period and were therefore operating at near the efficiency to be expected under ordinary conditions of service. Estimated values of illumination which would be furnished by the new high efficiency lamps, rated at an efficiency 50 per cent. higher than those adopted in these tests, are given.

Under the heading of "General Observations," it is stated that for classrooms of the size contemplated in future schools (24 ft. x 22 ft.), six fittings for the desk area are desirable in order to obtain the requisite uniformity of illumination. The report stresses the importance of avoidance of exposure of sources in the field of view, despite the relatively low brightness of fluorescent lamps (approx. 2½ candles per sq. in., increased to 4½ candles per sq. in. in the high efficiency lamps).

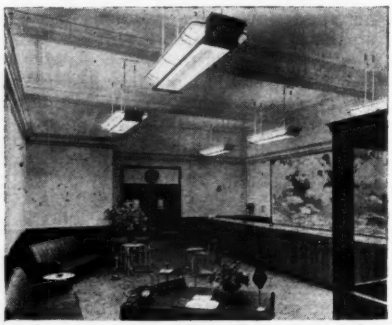
With a view to supplementing daylight, it is recommended that the lights nearest the inner wall should be controlled by a separate switch, and that consideration be given to the use of automatic photo-electric control so that artificial lighting is switched on whenever daylight has fallen to a prescribed value. Further experiments with coloured chalk and chalk-boards (e.g., blue chalk on a yellow board) are suggested. The importance of decoration, as an element in lighting, both as regards reflection of light and psychological effect, is emphasised. Class room windows should be provided with blinds having a light-coloured inner surface, both to prevent sun-glare and to facilitate redirection of light into the room.

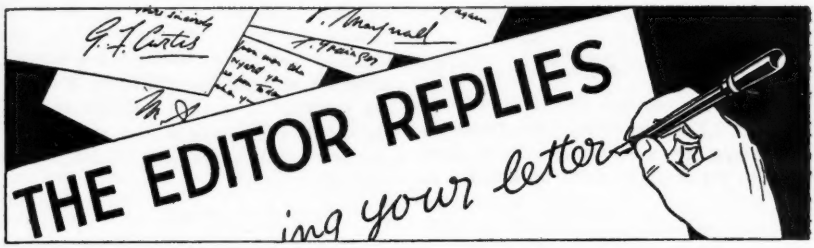
Fluorescent lighting is considered greatly superior on the ground of "acceptability." A comparison, based on equal quantity of light, is made between fluorescent and tungsten filament lighting. Assuming six fittings are used in all cases, installations used for 300 hours per annum, 10 years life for all fittings, and electricity at 3d. a unit, an annual cost of 1s. 6d. per lumen of fluorescent lighting and 2s. 1d. for filament lamp installations is arrived at. Any increase in the cost of electricity or in the number of hours of use per annum would give still greater economic advantage to fluorescent lighting.

Fluorescent Lighting

The accompanying picture, which is reproduced by kind permission of the American Overseas Airlines, shows the use of decorative fluorescent fittings in the booking hall of this organisation in Regent-street (London).

The installation was recently completed by Messrs. George Forrest and Son, Ltd., and has the pleasant features characteristic of well-designed fluorescent lighting.





I have been interested to receive a letter from Mr. H. A. Purdie, who is associated with Claude Neon Lights in Melbourne, and has promised to send me some illustrations of **an outstanding fluorescent lighting installation** in the "Skymaster" hangar of the Trans-Australia Airline at Essenden Airport, near Melbourne. One is always glad to get news from Australia, where, according to all accounts, much good work is being done.

I am not infrequently questioned about statements made at I.E.S. meetings. A case is afforded by Dr. Nelson's recent paper (see page 213), in which **1,000 foot-candles on the actual work** is suggested as an ideal. It is no doubt true that the graphs presented by Lythgoe and others indicate that an increase in visual acuity may persist to this value, and even beyond.

Nevertheless, I hold that such a value —apart from the obvious difficulty of securing such conditions in practice—is not, in ordinary circumstances, even an ideal to be aimed at. Even in the case of most exacting tasks, the gain in visual efficiency as one passes from, say, 100 to 1,000 foot-candles must be minute. One does not need the presumable increase from 90 per cent. (the value on which the I.E.S. code is based) to near 100 per cent. efficiency, and there are plenty of reasons, quite apart from light and vision, why such very high efficiencies are unrealisable in practice. On the other hand, there are surely many simple and easy tasks which are quite adequately performed with even 10 foot-candles and for which any possible gain through an increase in the illumination is scarcely worth having. All this is taken into consideration in the compilation of **the I.E.S. code.**

In another respect, however, i.e., the **brightness of the immediate background** to the task, the author might perhaps have been more explicit. Dr. Lythgoe's diagram shows, certainly, that "the immediate surround field should be comparable in brightness with the central field." But it goes beyond this. His diagram shows further that **in no case should the background be brighter** than the central field. It should be **darker**—but not very much darker; about **a quarter or a third of the central field brightness** seems to be the ideal.

Turning to another I.E.S. meeting, I have been asked what Professor Hartridge, in his entertaining lecture, intended to show when he carried out some **rotatory movements,** first in a clockwise and then in a counter-clockwise direction. I confess I did not quite follow this point myself. One member to whom I applied for information suggested, with his tongue in his cheek, that the lecturer was demonstrating how I.E.S. members of committees "retired in rotation"—a procedure which, I understand, has been the subject of

some discussion at recent council meetings.

I believe, however, that the point to be established was really the **tendency of the eye,** when moved rapidly, to **flick back to its original point of fixation,** a fact which, like very many others, the lecturer's polychromatic theory of vision offers to explain.

I fancy I have referred before to the **comparison** between values of illumination necessary by **natural light and artificial light** respectively. It has sometimes been suggested that the eye needs much higher values in daylight than under artificial light, whilst others have maintained the opposite. The question is of special interest in view of the recognition of the value of fluorescent lighting in supplementing daylight and the fact that work may often be conducted in a mixture of lights from both illuminants.

My own view is that the effect is largely psychological and the result of contrast. With bright sunlight outside or with the sky in full view, the eye may well crave an illumination much higher than would suffice at night time. On the other hand, I have observed that during periods of fading daylight the addition of quite a moderate artificial illumination seems to have a quite outstanding effect. But assuming there are no such marked contrasts to influence the eye and that one's judgment is based simply by **the appearance of the illuminated task,** I believe there is **no material difference** and that the I.E.S. code should answer equally well for natural and artificial light.

It is commonly assumed, no doubt quite correctly, that when fluorescent lighting is installed in a room receiving daylight from one side only, the tubes should be mounted parallel to the window line and **those most remote from the window controlled by a separate switch.** It is thus possible to augment the light where the daylight is weakest, without putting on the entire lighting.

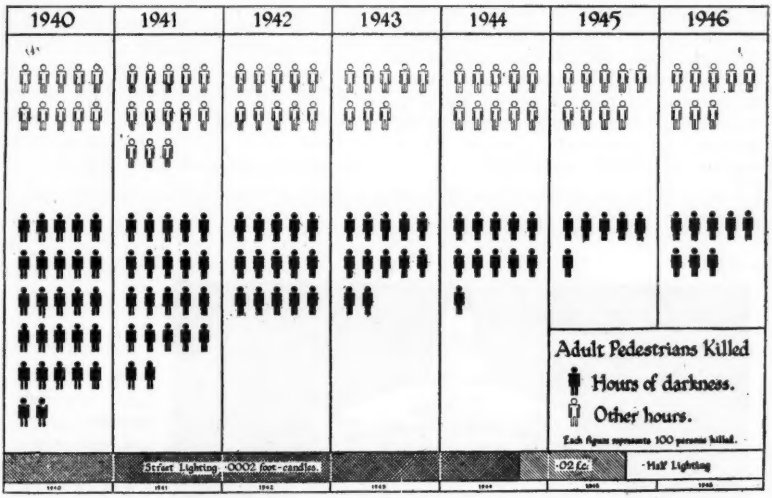
This, as stated, is quite correct in principle. I have met cases, however, where the lamps nearest the windows are in constant use but the back lights are only switched on infrequently. Evidence of this is afforded by the appearance of the lamps, those in the front of the room being obviously duller than those at the back owing to usage. There is a human tendency **to avoid the back regions of rooms** and for workers to get as near the windows as possible, or at least in the centre of the room. Moreover, even with relatively good admission of daylight such workers still tend to put on the fluorescent lighting constantly, throughout the winter.

Street Lighting and Road Safety

In a paper on the above subject, read at the recent A.P.L.E. Conference and presented in full in "Public Lighting" (July-September, 1947, p. 51), Mr. A. E. Marchant and Mr. Robert Bell recall recent history in street lighting. In September, 1939, all public lighting was extinguished. In December, 1939, "star-lighting" (0.0002-ft.c.) was permitted, which in September, 1944, was raised to "moonlighting" (0.02-ft.c.). Full street lighting was allowed for a short time in September, 1945, but thereafter a diminution to half was demanded and this (with the exception of almost complete banning during the Fuel Crisis) has continued up to the present time.

Yet, it is urged, good public lighting was never more necessary, and to provide full pre-war lighting less than 1 per cent. of additional fuel would be needed.

The influence of the black-out on road accidents is strikingly illustrated in the accompanying diagram. During the war period accidents during hours of darkness greatly exceeded those by day and it was not until 1946 that equality was restored. The restriction imposed on street lighting in March and April of the present year was, however, followed by a distinct increase in the number of accidents during hours of darkness. A very striking diagram presented by the authors showed the effect of better lighting in Victoria-street (London). In 1930, after the improvement, the number of accidents in winter was only about one fifth of that in 1928; whilst in summer the change was relatively small.



A comparison of the numbers of adult pedestrians killed in the streets during the period 1940—1946.

Street lighting is too often the Cinderella of municipal service. A diagram presented by the authors showed how small is the allocation to public lighting as compared with public health; moreover, it has altered little since 1934 whereas the rate allocated to public health has risen continuously. The economic value of street lighting is illustrated by the estimated cost of road

accidents during 1945—of the order of £100,000,000. Yet the lighting of all classified roads in County Boroughs and 20 per cent. of classified roads in Counties to a generous standard would cost only £3½ million—an amount that would surely be recouped through the saving in accidents.

Finally, there is the further consideration of the value of good street lighting in rendering easier the task of the police—more arduous than ever at the present time when the Police Force is admittedly undermanned and the war has left in its wake an inevitable tendency to disorder and crime. In this connection the authors quoted some statistics from American cities, for example, Cleveland, where 90 per cent. of crimes of violence take place after dark. There, after the installation of better lighting in one district, the crimes were shown to be only 60 per cent. of what would otherwise have been expected.

High Voltage Fluorescent Light Sources

A paper on the above subject was read before the I.E.S., Birmingham Centre, by Mr. H. G. Jenkins and Mr. J. N. Bowtell on November 7. The meeting was held in the large canteen of Messrs. Joseph Lucas, Ltd., and was arranged jointly with the Institution of Electrical Engineers and the Electrical Contractors Association. The paper, which was illustrated by numerous lantern slides and effective demonstrations, reviewed the development and possibilities of high voltage lighting, the use of the neon discharge to excite fluorescence, etc. A new type of neon-fluorescent tube giving a warm white light was discussed. It is of interest to recall that this paper is to be repeated in London next March.

Recent Patents

No. 590,585. Starting Arrangements for Electric Discharge Tubes. (*Lumalampan Aktiebolage. January* 28, 1944. *Convention Sweden.*)

This specification relates to a starting arrangement for electric discharge tubes designed to reduce the time between the switching on and starting of the tube. Instead of a glow starter an auxiliary discharge device is connected into the preheating circuit of the electrode, the arc discharge being made strong enough to heat the electrode of the fluorescent lamp to emission temperature directly after closing the switch.

No. 590,615. Improvements in Fluorescent Electric Lighting Fittings. (*Veritys, Ltd., and J. W. Forth. November* 17, 1944.)

This specification refers to a fluorescent lighting reflector fitting or installation thereof in which the control gear is arranged on the exterior of an end or ends of the trough sectional reflector and is enclosed by removable covers.

No. 590,703. Improvements in and relating to Electric Discharge Lamps. (*The General Electric Co., Ltd., and R. L. Brendner, H. G. Jenkins, and C. H. Simms. December* 21, 1944.)

This specification relates to electric discharge lamps of both the cold and hot cathode types in which compactness is secured by giving the passage through which the discharge passes between the electrodes a spiral shape. The discharge passage is a channel formed between two vitreous components, the walls of the passage being coated with luminescent material.

No. 591,100. Improvements in Flameproof and similar industrial Well-Glass Lighting Fittings (*Holophane, Ltd., and S. English. May* 25, 1943.)

This specification refers to a lighting fitting comprising a metal housing carrying beneath it a well glass and within it a lamp holder so placed as to bring the lamp filament below the rim of the housing, the housing also supporting a translucent screen so that light emitted within a small angle below the horizontal is reduced to a prescribed tolerable brightness. The screen may also be transparent and prismatic or may act as a reflector.

No. 591,192. Improvements on or relating to Mountings for Electric Strip Lamps. (*L. H. Huckett. May* 1, 1945.)

This specification relates to electric strip lamps having supply contacts at each end. The construction comprises a casing containing a lamp-holding and current-conducting unit which includes at least one current conducting plate which is formed to provide a support at one end of the lamp and carries the corresponding lamp contact. The electrical connection for the contact at the other end of the lamp is also supported by this plate though insulated from it.

No. 591,415. Lighting Device for use in Shaving. (*J. Klaw. January* 16, 1946.)

This specification relates to a device comprising a holder for an electric bulb, the holder having means for connecting it to the handle of a safety razor so that a beam of light from the lamp can be concentrated on the face in the locality of the cutting edge of the razor.

No. 591,527. Improvements in and relating to Chokes for Electric Discharge Lighting. (*Crompton Parkinson, Ltd., A. L. Randall, F. J. Templeton, and F. Seaborne. May* 11, 1945.)

This specification relates to a choke comprising a body portion adapted to form part of the suspension system for electric discharge tubes. The body has a detachable top cover adapted to be secured to the ceiling, conduit box, or to a suspension tube, chain, etc. The base of the choke is adapted to be secured to the reflector on casing of the lighting unit.

LIGHT AND LIGHTING

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